ARRAYS, SUBSTRATES, DEVICES, METHODS AND SYSTEMS FOR DETECTING TARGET MOLECULES

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Application entitled "An Integrated Blood Platform for Blood Separation and Protein Detection" Ser. No. 60/959,666, filed on Jul. 16, 2007 Docket No. CIT4943-P, and to U.S. Provisional Application entitled "High-Density Bar-code Array: A Generic Patterning Technique and Biodetection Devices Fabricated Therefrom" Ser. No. 60/998,981 filed on Oct. 15, 2007 Docket No. CIT-5017, the disclosures of both of which are incorporated herein by reference in their entirety. The Application is also related to the U.S. application entitled "Methods and Systems for Detecting and/or Sorting Targets" Ser. No. 11/888,502 filed on Aug. 1, 2007, Docket Number P017-US, and to U.S. application entitled "Microfluidic Devices, Methods and Systems for Detecting Target Molecules" Serial No. to be assigned filed on Jul. 16, 2008, Docket Number P235-US, the disclosures of both of which are also incorporated herein by reference in their entirety.

STATEMENT OF GOVERNMENT GRANT

[0002] The U.S. Government has certain rights in this disclosure pursuant to Grant No. CA119347 awarded by the National Institutes of Health.

TECHNICAL FIELD

[0003] The present disclosure relates to patterning of materials, performance of assays and in particular detection of target molecules in a sample. More specifically, it relates to arrays, devices, methods and systems for detecting a plurality of target molecules in a sample.

BACKGROUND

[0004] Detection of target molecules and in particular of biomarkers has been a challenge in the field of biological molecule analysis. In particular, qualitative and quantitative detection of biomarkers is often a critical step in several applications ranging from diagnostics to fundamental biology studies.

[0005] In particular, qualitative and quantitative detection of multiple biomarkers has become increasingly important in several applications, such as clinical diagnostic wherein accurate detection of a plurality of biomarkers is desired. More particularly, in some of those applications detection of the multiple biomarkers is directed to identify a biological profile (e.g. proteome and/or metabolome) which can be associated to an indication of interest (e.g. a diagnostic indication).

[0006] Detection of multiple biomarkers is performed by several surface-bound assays known in the art. In those assays capture agents (e.g. primary antibodies) attached to a surface (e.g. a substrate surface) bind the targets of interest in capture agent binding complexes. The capture agent binding complexes are then detected, typically through further binding of the targets with labeling molecules (e.g. secondary antibodies coupled with fluorescent dyes).

[0007] A number of critical parameters is associated with successful execution of a surface-bound assay and include: a) sensitivity of the assay, or minimum concentration, of the biomolecule that can be detected, b) concentration range over which that biomolecule can be detected, c) numbers of different biomolecules that can simultaneously be detected, d) variability from measurement to measurement, e) numbers of different types of biomolecules (e.g. mRNAs, proteins, etc.) that can simultaneously be detected, f) minimum sample size required for the measurement, and g) speed at which the measurement can be performed.

[0008] A number of those assays are typically performed in a microfluidic environment. Microfluidics-based assays are particularly attractive for applications where minimum sample size and short time of execution are desired, because they require only small amounts of biological materials and small amounts of capture agents, materials and associated reagents.

SUMMARY

[0009] Provided herein, are devices, methods and systems for detection of a plurality of targets that allow a fast and sensitive detection of a large number of multiple targets in a sample and/or provide results in an easily readable fashion.

[0010] According to a first aspect, an array for detecting at least one target in a sample, and in particular a plurality of targets in a sample is disclosed. The array comprises, at least one capture agent or component thereof attached to a substrate, the at least one capture agent capable of specifically binding the at least one target to form a capture agent target binding complex. In the array, the at least one capture agent or component thereof arranged on the array so that capture agent target binding complexes are detectable along substantially parallel lines forming a barcoded pattern. The at least one target can be a plurality of targets, the capture agent can be a plurality of capture agents, with each capture agent of the plurality of capture agents bindingly distinguishable and positionally distinguishable from another and capable of specifically binding each target of the plurality of targets to form a capture agent target binding complex.

[0011] According to a second aspect, a microfluidic device is disclosed that comprises an array according to the present disclosure.

[0012] According to a third aspect, a system for the detection of a plurality of targets in a sample is disclosed. The system comprises an array disclosed herein and a device for detecting the barcoded pattern on the array.

[0013] According to a fourth aspect, a method for detecting a plurality of targets in a sample is disclosed. The method comprises: contacting said sample with an array herein disclosed for a time and under conditions to allow binding of said plurality of targets with said plurality of capture agents to form capture agent target binding complexes; and detecting said capture agent target binding complexes.

[0014] According to a fifth aspect, a substrate is disclosed, the substrate for detecting a target, and in particular a plurality of targets, in a sample. The substrate is configured to allow attachment of the target on the substrate so that said target is detectable along substantially parallel lines forming a barcoded pattern.

[0015] According to a sixth aspect, a microfluidic device is disclosed that comprises a substrate according to the present disclosure.

[0016] According to a seventh aspect, a system for the detection of a target, and in particular a plurality of targets, in